COMMON QUARTERLY EXAMINATION - 2024

Standard XII

Reg.No. | | | | | | |

PHYSICS

Time : 3.00 hrs **Part - I** **Marks : 70**

I. Choose the correct answer: **15 x 1 = 15**

1. In a transformer, the number of turns in the primary and the secondary are 410 and 1230 respectively. If the current in primary is 6A, then that in the secondary coil is
   a) 2 A b) 18 A c) 12 A d) 1 A
2. In an oscillating LC circuit, the maximum charge on the capacitor is Q, the charge on the capacitor when the energy is stored equally between the electric and magnetic field is
   a) $\frac{Q}{2}$ b) $\frac{Q}{\sqrt{3}}$ c) $\frac{Q}{\sqrt{2}}$ d) Q
3. In Fleming's right hand rule, the fore finger represents the direction of
   a) motion of the conductor b) magnetic field
   c) induced current d) none of the above
4. Two identical conducting balls having positive charges q_1 and q_2 are separated by a center to center distance r. If they are made to touch each other and then separated to the same distance, the force between them will be
   a) less than before b) same as before
   c) more than before d) zero
5. Which charge configuration produces a uniform electric field?
   a) point charge b) uniformly charged infinite line
   c) uniformly charged infinite plane d) uniformly charged spherical shell
6. The unit for electric flux is
   a) $C^2N^{-1}m^{-2}$ b) $N\,m^2\,C^{-2}$ c) $N\,m^2\,C^{-1}$ d) $N\,m^{-2}\,C^{-1}$
7. The electric and magnetic fields of an electromagnetic wave are
   a) In phase and perpendicular to each other
   b) Out of phase and not perpendicular to each other
   c) In phase and not perpendicular to each other
   d) Out of phase and perpendicular to each other

8. Which one of them is used to produce a propagating electromagnetic wave?
   a) an accelerating charge
   b) a charge moving with constant velocity
   c) a stationary charge
   d) an uncharged particle

9. A toaster operating at 240 V has a resistance of 120 Ω. Its power is
   a) 400 W b) 2 W c) 480 W d) 240 W

10. A carbon resistor of (47 ± 4.7) kΩ to be marked with rings of different colours for its identification. The colour code sequence will be
   a) yellow – green – violet – gold
   b) yellow – violet – orange – silver
   c) violet – yellow – orange – silver
   d) green – orange – violet – gold

11. The speed of light in an isotropic medium depends on
   a) its intensity
   b) its wavelength.
   c) the nature of propagation
   d) the motion of the source with respect to medium

12. Stars twinkle due to
   a) reflection
   b) total internal reflection
   c) refraction
   d) polarisation

13. The ratio of magnetic length and geometrical length is
   a) 0.833 b) 0.633 c) 0.933 d) 0.733

14. A particle having mass m and charge q accelerated through a potential difference V. Find the force experienced when it is kept under perpendicular magnetic field $\vec{B}$.
   a) $\sqrt{\frac{2q^3BV}{m}}$ b) $\sqrt{\frac{q^3B^2V}{2m}}$ c) $\sqrt{\frac{2q^3B^2V}{m}}$ d) $\sqrt{\frac{2q^3BV}{m^3}}$

15. The vertical component of Earth's magnetic field at a place is equal to the horizontal component. What is the value of angle dip at this place?
   a) 30° b) 45° c) 60° d) 90°

Part - II

II. Answer any 6 questions. (Q.No.21 is compulsory) **6 x 2 = 12**

16. What is corona discharge?
17. Distinguish between drift velocity and mobility.
18. State Biot-Savart's law.
19. How will you define Q-factor?
20. The electric field lines never intersect - Justify.
21. Determine the number of electrons flowing per second through a conductor, when a current of 32 A flows through it.
22. Give two uses of IR radiation.
23. Write the two conditions for total internal reflection.
24. A 400 mH coil of negligible resistance is connected to an AC circuit in which an effective current of 6 mA is flowing. Find out the voltage across the coil if the frequency is 1000 Hz.

Part - III

III. Answer any 6 questions. (Q.No.30 is compulsory) **6 x 3 = 18**

25. What are the differences between coulomb force and gravitational force?
26. Explain the equivalent resistance of a series resistor network.
27. Obtain Gauss law from Coulomb's law.
28. Give the properties of dia / para / ferromagnetic materials.
29. How will you induce an emf by changing the area enclosed by the coil?
30. A coil of a tangent galvanometer of diameter 0.24 m has 100 turns. If the horizontal component of Earth's magnetic field is 25×10^{-6} T, then calculate the current which gives a deflection of 60°.
31. Write down Maxwell equations in integral form.
32. Derive the relation between f and R for a spherical mirror.
33. A monochromatic light is incident on an equilateral prism at an angle 30° and is emergent at an angle of 75°. What is the angle of deviation produced by the prism.

Part - IV

IV. Answer all the questions. 5 x 5 = 25

34. a) Calculate the electric field due to a dipole at a point on the axial line.

(OR)

b) Describe the Fizeau's method to determine speed of light.

35. a) Explain the determination of the internal resistance of a cell using voltmeter.

(OR)

b) Explain the types of emission spectrum.

36. a) Deduce the relation for the magnetic field at a point due to an infinitely long straight conductor carrying current using Biot-Savart law.

(OR)

b) Explain the construction and working of transformer.

37. a) Derive the mirror equation and the equation for lateral magnification.

(OR)

b) Obtain the condition for bridge balance in Wheatstone's bridge.

38. a) Explain in detail the construction and the working of a Van de Graaff generator.

(OR)

b) Derive an expression for phase angle between the applied voltage and current in a series RLC circuit.

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Common Quarterly examination - 2024

+2 physics

Key points

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part - A

1) (a) 2A

2) (c) $\frac{Q}{\sqrt{2}}$

3) (b) Magnetic field

4) more than before.

5) Uniformly charged infinite plane.

6) ~~$C^2 N^{-1} m^{-2}$~~ Nm^2C^{-1}

7) (a) In phase and perpendicular to each other

8) (a) an accelerating charge.

9) 480W (c)

10) (b) Yellow - violet - orange - silver

11) (b) its wavelength.

12) (c) refraction (or) (b) Total internal reflection (both answers are correct)

13) (a) 0.833

14) (c) $\sqrt{\frac{2q^3B^2V}{m}}$

15) 45° (b)

part - B

(Q. No: 21 is compulsory)

16) Corona discharge:

The positive ions are repelled at the sharp edges.

17) Drift velocity

$V_d = aT$

velocity acquired by the electrons

Mobility

$\mu = \frac{eT}{m}$ (or) $\frac{|\vec{V}_d|}{|E|}$

charge carriers magnitude per unit electric field.

18) Biot-Savart law

Magnitude form $d\bar{B} = \frac{I dl \sin\theta}{r^2}$

Vector form $d\bar{B} = \frac{I dl}{r^2} \hat{r}$

$dB \propto I$ $dB \propto dl$ $dB \propto \sin\theta$ $dB \propto \frac{1}{r^2}$

19) Q - factor

$$Q\text{-factor} = \frac{\text{Voltage across L (or) C}}{\text{Applied voltage}} = \frac{I_m X_L}{I_m R}$$

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

20) Electric field lines never intersect, at the point of intersection, two tangents can be drawn to the two lines of force.

21) $I = 32\ A$ $\quad I = \frac{Q}{t}$ $\quad Q = ne$

$I = \frac{ne}{t}$ $\quad Ixt = Q$

$Ixt = ne$

$\frac{32 \times 1}{1.6 \times 10^{-19}} = n$ $\quad \frac{Ixt}{e} = n$

$20 \times 10^{19} = n$ charges

22) Uses of IR Radiation

(i) Electrical energy to satellite, Heat therapy, Muscular pain relief

(ii) TV remote sensing, signal carrier.

23) Total internal reflection.

(i) Angle of incident is greater than Critical angle (i_c)

(ii) Light travels from Denser medium to rarer medium (or) rarer medium to Denser medium

24) $L = 400 \times 10^{-3}\ H$ $I_{eff} = 6 \times 10^{-3}\ A$

$f = 1000\ Hz$

$X_L = L\omega = L \times 2\pi f$

$X_L = 2 \times 3.14 \times 1000 \times 0.4$

$\boxed{X_L = 2512\ \Omega}$

$V = I X_L = 6 \times 10^{-3} \times 2512$

$\boxed{V = 15.072\ V}$ RMS value.

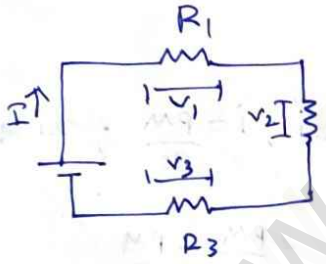
Part - III

(Q. No 30 is Compulsory)

25)

Coulomb force	gravitational force
(i) $F = \hat{k}\frac{q_1 q_2}{r^2}$	(i) $F = G\frac{m_1 m_2}{r^2}$
(ii) Attractive and repulsive	(ii) only attractive
(iii) charge dependent	(iii) Mass dependent.

26)



$V_{tot} = V_1 + V_2 + V_3$

$V_1 = IR_1$, $V_2 = IR_2$, $V_3 = IR_3$

$V_{tot} = IR_1 + IR_2 + IR_3$

$IR_S = I(R_1 + R_2 + R_3)$

$\boxed{R_S = R_1 + R_2 + R_3}$

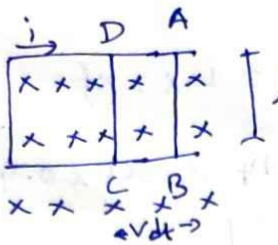
27) Gauss law from Coulomb's law

$\oint \bar{E} \cdot d\bar{A} = \frac{Q_{enclosed}}{\varepsilon_0}$ net electric flux to net electric charge enclosed in a surface.

28) dia, para and ferro magnetic material.

dia	para	ferro
χ_m ~~positive~~ negative	χ_m positive	χ_m positive large
$\mu_r < 1$ (e-g) Bi	$\mu_r > 1$ (e-g) Al.	$\mu_r > 1$ (e-g) Fe, Ni, Co
~~χ_m constant~~	$\chi_m \propto \frac{1}{T}$	$\chi_m \propto \frac{1}{T}$
Temperature independent.	Temperature dependent	Temperature dependent

29) Induce an emf by changing area of the coil



$d\phi_B = B \times ABCD$

$d\phi_B = Bl v.dt$

$ABCD = l(v\,dt)$

$$\frac{d\phi_B}{dt} = Blv \qquad \varepsilon = Blv$$

30)

$\theta = 60^\circ \quad \tan 60^\circ = \sqrt{3} = 1.732$

$$I = \frac{2RBH}{\mu_0 N}\tan\theta \Rightarrow \frac{2 \times 0.12 \times 25 \times 10^{-6}}{4\times10^{-7} \times 3.14 \times 100} \times 1.732$$

$$I = 0.082A$$

31)

I^st equation

$$\oint E.dA = \frac{q_{end}}{\varepsilon_0}$$

II^nd equation

$$\oint B.dA = 0$$

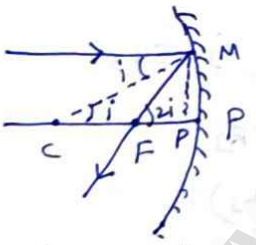
III^rd equation

$$\oint E.dl = -\frac{d}{dt}\phi_B$$

IV^th equation

$$\oint B.dl = \mu_0 I_{end} + \mu_0 \varepsilon_0 \frac{d}{dt}\int \vec{E}.d\vec{A}$$

32) Relation b/w f and R.



$\tan i = \frac{PM}{PC}$ $\quad \tan 2i = \frac{PM}{PF}$

$\tan i \approx i$; $i = \frac{PM}{PC}$; $2i = \frac{PM}{PF}$

$$\frac{2PM}{PC} = \frac{PM}{PF}$$

$2f = R \quad f = \frac{R}{2}$

33)

$A = 60^\circ \quad i_1 = 30^\circ, \; i_2 = 75^\circ$

$d = i_1 + i_2 - A$

$d = 30^\circ + 75^\circ - 60^\circ$

$= 105^\circ - 60^\circ$

$d = 45^\circ$

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Exam .....

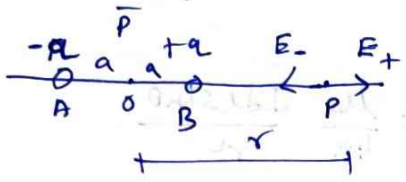
Class : .....

Subject : .....

Date : ..... Sign : .....

Part - D IV

34 (a) Electric field due to a dipole (axial line)



$$\bar{E}_+ = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2}\hat{p}$$

$$E_- = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r+a)^2}\hat{p}$$

$$\bar{E}_{tot} = |\bar{E}_+| + |\bar{E}_-|$$

$$E = \frac{1}{4\pi\varepsilon_0} q\left[\frac{4ra}{(r^2-a^2)^2}\right]\hat{p}$$

$r >> a$

$$\bar{E}_{tot} = \frac{1}{4\pi\varepsilon_0}\left[\frac{4aq}{r^3}\right]\hat{p}$$

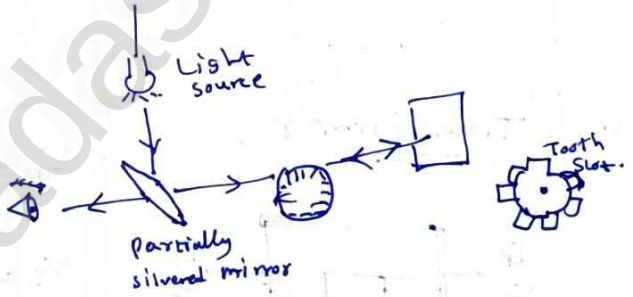
$$\bar{E} = \frac{1}{4\pi\varepsilon_0}\frac{2\bar{p}}{r^3}$$

34 (b) Fizeau's method

$$V = \frac{2d}{t}, \quad \omega = \frac{\theta}{t}$$

$$\theta = \frac{2\pi}{2N} = \frac{\pi}{N}$$

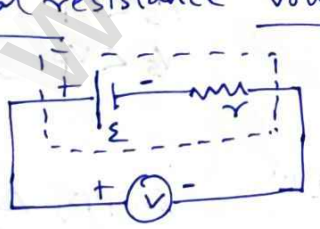
$$\omega = \frac{\pi/N}{t} = \frac{\pi}{Nt}$$

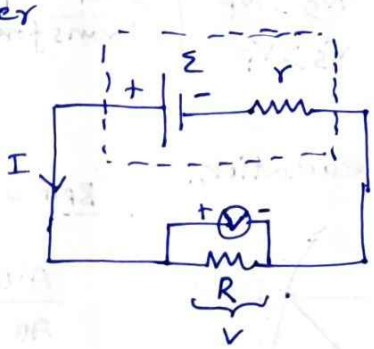


$$V = \frac{2d}{\pi/N\omega}$$

$$V = 2.99792 \times 10^8 \text{ m/s}$$

35) (a) Internal resistance voltmeter





$$V = IR$$

$$V = \varepsilon - Ir$$

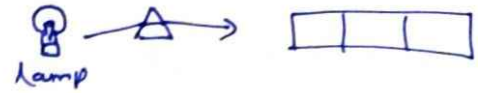
$$Ir = \varepsilon - V$$

$$\frac{Ir}{IR} = \frac{\varepsilon - V}{V}$$

$$r = R\left(\frac{\varepsilon - V}{V}\right)$$

35 (b) Emission spectra

(i) Continuous emission spectra → Incandescent lamp, Carbon arc

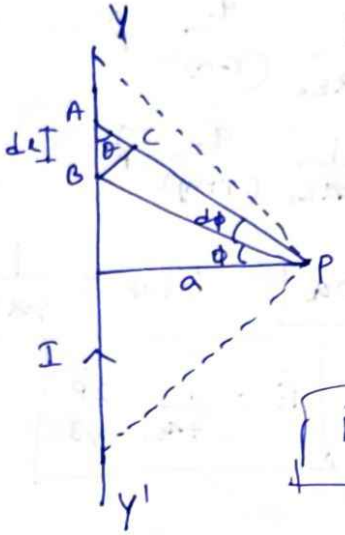


(ii) Line emission spectra (spectra of H, He)

(iii) Band emission spectra.

(e-g) Hydrogen gas, ammonia gas

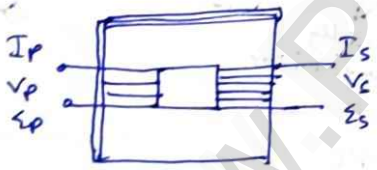
36 (a)



$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I\,dl\sin\theta}{r^2}$$

$$\vec{B} = \frac{\mu_0 I}{2\pi a}\hat{n}$$

36 (b) Transformer



$$V_p = \mathcal{E}_p = -N_p \frac{d\phi_B}{dt}$$

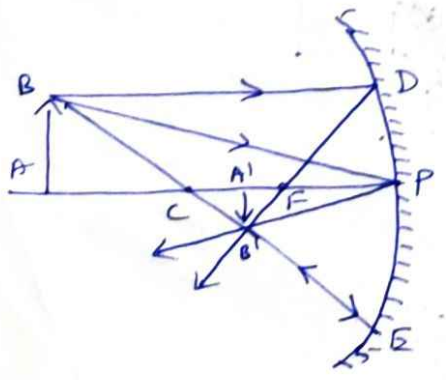
$$V_s = \mathcal{E}_s = -N_s \frac{d\phi_B}{dt}$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = K \qquad \frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{i_p}{i_s} = K$$

$K > 1$, $N_s > N_p$, $V_s > V_p$ } Step-up transformer

$K < 1$, $N_s < N_p$, $V_s < V_p$ } Step-down transformer

37 (a) Mirror equation.



$\angle BPA = \angle B'PA'$

ΔDPF, $\Delta B'A'F$

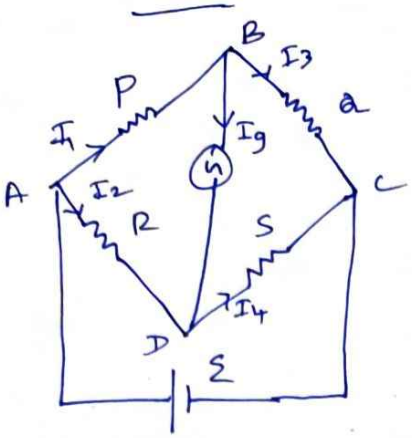
$$\frac{A'B'}{AB} = \frac{PA'}{PA} \quad ; \quad \frac{A'B'}{AB} = \frac{A'F}{PF}$$

$$\frac{PA'}{PA} = \frac{A'F}{PF} \Rightarrow \frac{PA'}{PA} = \frac{PA'-PF}{PF}$$

$PA = -u$ $PA' = -v$ $P = -f$

$$\frac{v}{u} = \frac{v-f}{f} \Rightarrow \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

37 (b) Wheatstone's Bridge



$I_1 - I_g - I_3 = 0 \rightarrow (1)$

$I_2 + I_g - I_4 = 0 \rightarrow (2)$

$I_1 P + I_g G - I_2 R = 0 \rightarrow (3)$

$I_1 P + I_3 Q - I_4 S - I_2 R = 0 \rightarrow (4)$

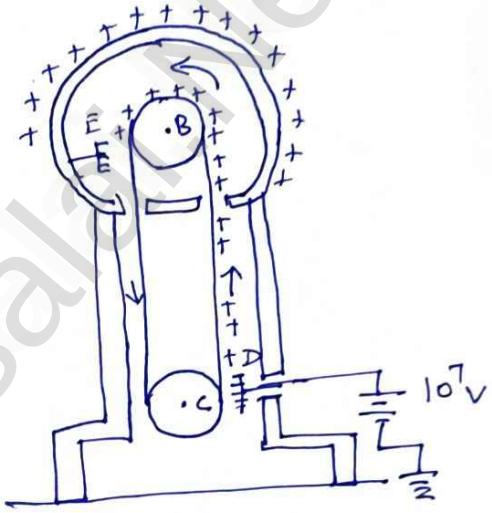
$I_1 = I_3$ $I_2 = I_4$ $I_1 P = I_2 R$

$$\frac{P}{Q} = \frac{R}{S}$$

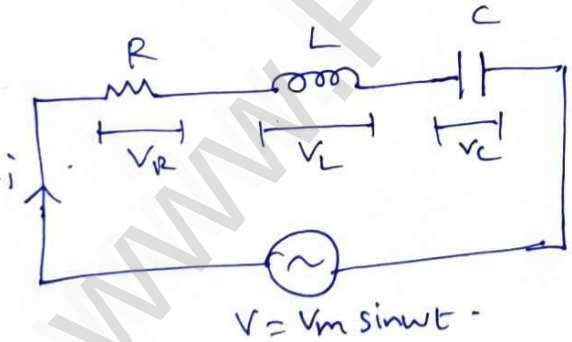
32 (a) Van de graff generator

principle: Corona discharge (or) Electro static induction

Van de graff generator is used to accelerate positive ions.



38 (b) RLC circuit



$\theta I = I_m$

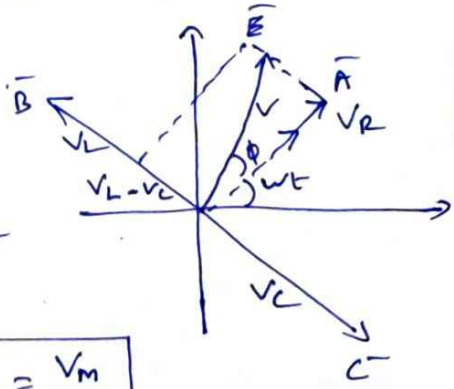
$\theta A = I_m R$

$OB = I_m X_L$

$OC = I_m X_C$

$V_L > V_C$

$V_L - V_C$



$$V_m^2 = V_R^2 + (V_L - V_C)^2$$

$$= \sqrt{(I_m R)^2 + (I_m X_L - I_m X_C)^2}$$

$$I_m = \frac{V_m}{\sqrt{R^2 + (X_L - X_C)^2}}$$

$$I_m = \frac{V_m}{Z}$$

$$\tan\phi = \frac{X_L - X_C}{R}$$